

APPENDIX 3.6-C

Support Information for Dewey-Burdock Meteorological Monitoring Site

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APPENDIX 3.6-C: SUPPORT INFORMATION FOR DEWEY-BURDOCK METEOROLOGICAL MONITORING SITE

The following presents the stability classes and joint frequency distribution for the Dewey-Burdock permit area and describes the methodology used for calculations. Atmospheric stability class can be derived from solar radiation during the daylight hours, and vertical temperature gradient (delta-T) measurements during the nighttime hours according to the SRDT (solar radiation delta-T) method. However, meteorological monitoring at the Dewey-Burdock site included solar radiation but not delta-T. In the absence of the delta-T measurements required by the SRDT method, a possible modification was considered. This modified SRDT approach would assume a positive delta-T (increasing temperature with height) during nighttime hours, thereby producing the most stable class possible and, therefore, the lowest modeled pollutant dispersion.

Another alternative to determine atmospheric stability classes and resulting joint frequency distributions is the sigma theta method. This method is turbulence-based, which uses the standard deviation of the horizontal wind direction (σ_θ) in combination with the scalar mean wind speed. Since σ_θ was not logged, it was necessary to derive this parameter from the hourly variation of 5-minute wind directions.

The procedure for deriving hourly average σ_θ values is outlined as follows:

1. Compute a scalar mean wind direction by averaging 5-minute azimuth angles over four, 15-minute periods for each hour. The choice of 15-minute averaging periods is intended to minimize the effect of wind meander (wind direction changes over longer periods that are non-random and unrelated to turbulence). The use of 5-minute source data further reduces the likelihood of conflicts between scalar and vector averages.
2. Compute a standard deviation of each 15-minute grouping of 5-minute wind directions, based on the differences between the 5-minute readings and the 15-minute mean from step 1 above.
3. Compute an hourly average standard deviation as the geometric average of the four 15-minute standard deviations from step 2 above.

Steps 1 and 2 utilize the Mitsua method: $\bar{\theta} = \frac{1}{N} \sum_1^N D_i$ (N = 3 in this case)

where

$D_i = \theta_i;$	for $i = 1$
$D_i = D_{i-1} + \delta_i + 360;$	for $\delta_i < -180$ and $i > 1$
$D_i = D_{i-1} + \delta_i;$	for $ \delta_i < 180$ and $i > 1$
$D_i = D_{i-1} + \delta_i - 360;$	for $\delta_i > 180$ and $i > 1$
$D_i = \text{undefined};$	for $\delta_i = 180$ and $i > 1$
$\delta_i = \theta_i - D_{i-1};$	for $i > 1$

θ_i is the azimuth angle of the wind vane for the i^{th} sample

then

$$\sigma_{\theta} = \left\{ \frac{1}{N} \sum_1^N D_i^2 - \frac{1}{N} \left(\sum_1^N D_i \right)^2 \right\}^{1/2}$$

In step 3, the hourly average standard deviation can then be calculated from these 15-minute values:

$$\sigma_{\theta}(1-hr) = \sqrt{\frac{(\sigma_{\theta_1})^2 + (\sigma_{\theta_2})^2 + (\sigma_{\theta_3})^2 + (\sigma_{\theta_4})^2}{4}}$$

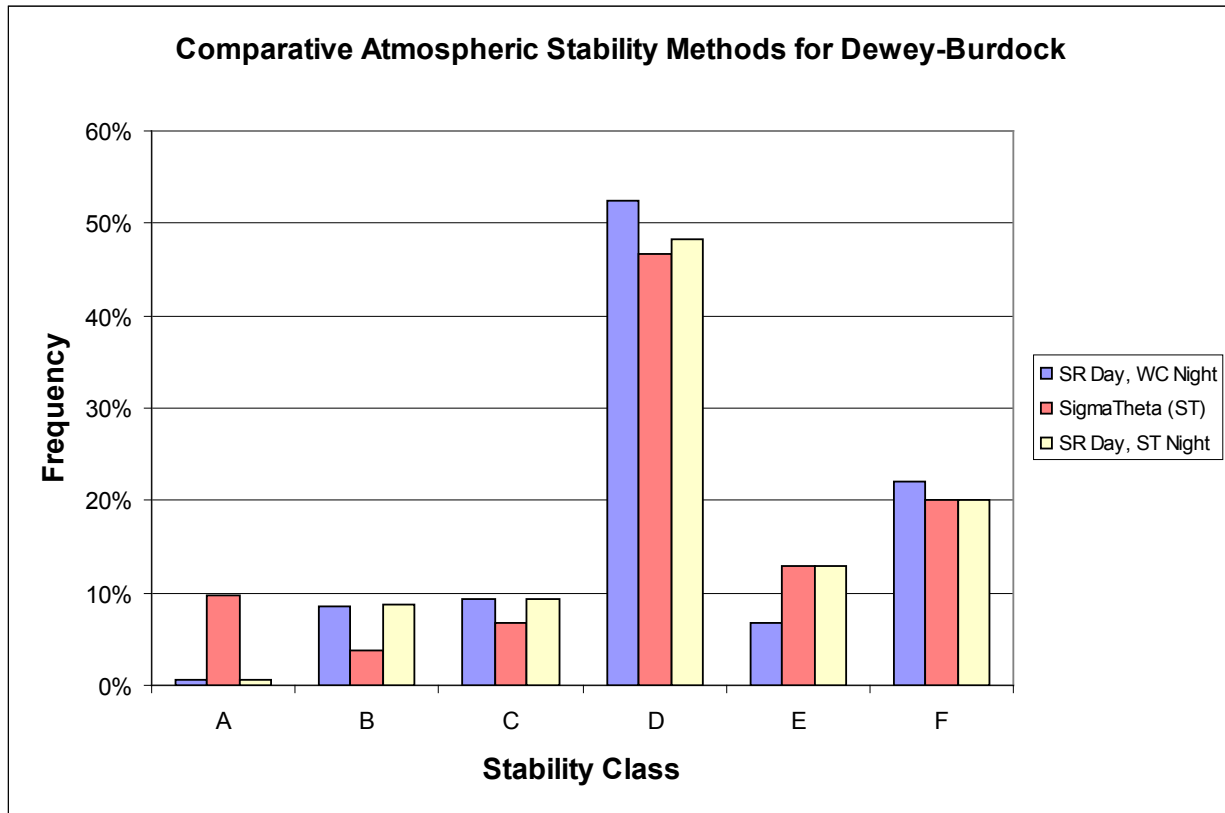
The above procedure, when applied to the Dewey-Burdock wind data, yields hourly σ_{θ} values similar to the hourly values logged at the nearby Newcastle meteorological station. Newcastle σ_{θ} values averaged 19.6° during the baseline monitoring year, while the derived σ_{θ} values from Dewey-Burdock data averaged 18.7°. The sigma theta method of atmospheric stability determination is considered more representative than the modified SRDT method described above, because it requires no simplifying assumptions.

Having developed these hourly σ_{θ} values, however, the choice remained whether to use the sigma theta method exclusively, or to use a hybrid method that takes advantage of solar radiation (SR) data during the daytime. To facilitate this choice, the two methods were compared along with the modified SRDT method which used SR during the day, and assumed worst-case delta-T (WC) at night. Figure 1 shows the results of this comparison.

The sigma theta method was ruled out since it resulted in a much higher percentage of the hours in the least stable class. Stability class A produces the greatest amount of atmospheric mixing and pollutant dispersion, so the sigma theta method compromises the preference for conservatism. The remaining two methods yield similar results. The hybrid SR/ST method was chosen because it makes use of the greatest amount of monitoring data covering both daytime and nighttime.

Based upon the data and method selections discussed above, the combination of hourly wind speed, wind direction and stability class was used to generate Joint Frequency Distributions (JFDs) for the anticipated release height of 10 meters. The annual JFD in Table 1 was used as the basis for a revised MILDOS-AREA model run. The 1st Quarter JFD in Table 2 reflects January 1, 2008 through March 31, 2008. Table 3 reflects 2nd Quarter (April 1, 2008 through June 30, 2008). Table 4 reflects the 3rd Quarter (July 2007 and 2008 and August 1, 2007 through September 30, 2007). Table 5 reflects the 4th Quarter (October 1, 2007 through December 31, 2007). Each table footer shows the number of hours for which valid data are available, the total number of hours possible, and the number of calm hours during the period represented.

Figure 1: Comparative Atmospheric Stability Methods for Dewey-Burdock



Data recoveries at the 3-meter level exceeded 99%. However, regulatory guidance specifies that wind characteristics should reflect the anticipated release height for modeled emission sources. Therefore, the joint frequency distributions depicted below are based on 10-meter wind data. Joint data recovery (wind speed and wind direction) for the baseline year was 87%, above the recommended minimum of 75% (Reference 3). Individual data recovery was also around 87%, slightly below the recommended 90% for individual parameters (Reference 3). However, the tradeoff between marginal recovery percentage and representative height above the ground appears justified in this case.

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Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 1.22%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE		0.000131					0.000131
	NE							
	ENE							
	E							
	ESE	0.000274						0.000274
	SE		0.000262					0.000262
	SSE	0.000274	0.000393					0.000667
	S	0.000274	0.000524					0.000798
	SSW	0.000411	0.000786					0.001197
	SW	0.000411	0.000393					0.000804
	WSW	0.000137	0.000786					0.000923
	W	0.000274	0.000393					0.000667
	WNW	0.000411	0.000524					0.000935
	NW							
NNW								
B	N	0.002740	0.000524					0.003264
	NNE	0.001096						0.001096
	NE	0.001096						0.001096
	ENE	0.000822	0.000262					0.001084
	E	0.000822	0.000131	0.000131				0.001084
	ESE	0.000411	0.000393	0.000655				0.001459
	SE	0.001781	0.001964	0.002095				0.005841
	SSE	0.002603	0.004191	0.001441				0.008234
	S	0.005206	0.003143	0.000524				0.008872
	SSW	0.005069	0.001702	0.000131				0.006902
	SW	0.003562	0.002226	0.000393				0.006181
	WSW	0.003699	0.002881	0.000262				0.006842
	W	0.003836	0.005369	0.001441				0.010646
	WNW	0.004384	0.004191	0.003405				0.011979
	NW	0.004384	0.001833	0.000917				0.007134
NNW	0.003973	0.001048	0.000131				0.005151	
C	N		0.001310					0.001310
	NNE		0.000393					0.000393
	NE		0.000131					0.000131
	ENE		0.000262	0.000131				0.000393
	E		0.001310	0.001702	0.000131			0.003143
	ESE		0.001964	0.003274	0.000131			0.005369
	SE		0.003798	0.004191	0.000131			0.008119
	SSE		0.004845	0.003405				0.008250
	S		0.005500	0.000786				0.006286
	SSW		0.001572	0.000917				0.002488
	SW		0.001702	0.000655				0.002357
	WSW		0.003929	0.001310				0.005238
	W		0.006548	0.001310	0.000393			0.008250
	WNW		0.011524	0.008905	0.000131	0.000393		0.020953
	NW		0.007072	0.004845	0.001441	0.000393		0.013751
NNW		0.005107	0.001833				0.006941	

Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - One Year						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.008493	0.010215	0.002226	0.001310	0.000393		0.022637
	NNE	0.007671	0.004976	0.001702	0.000524		0.000131	0.015005
	NE	0.002740	0.002750	0.004060	0.002357	0.000131	0.000393	0.012431
	ENE	0.001781	0.005631	0.012834	0.013751	0.002357	0.002095	0.038449
	E	0.003288	0.007596	0.024227	0.016370	0.001572	0.000655	0.053707
	ESE	0.001644	0.007858	0.011655	0.009691	0.000917		0.031764
	SE	0.001096	0.006024	0.007727	0.002226	0.000262		0.017335
	SSE	0.002740	0.004584	0.004060	0.001441	0.000393		0.013216
	S	0.002740	0.003012	0.001048	0.000131			0.006930
	SSW	0.003425	0.001964	0.001441	0.000393			0.007222
	SW	0.001370	0.000917	0.002095	0.002488	0.000917	0.000131	0.007918
	WSW	0.002329	0.002226	0.002619	0.003274	0.001048	0.000655	0.012151
	W	0.001644	0.003536	0.003274	0.003405	0.001702	0.000131	0.013692
	WNW	0.003699	0.011655	0.018989	0.021870	0.004453	0.000393	0.061059
	NW	0.005617	0.016370	0.038371	0.047669	0.019120	0.003143	0.130289
NNW	0.006575	0.015191	0.008643	0.005631	0.001833	0.000393	0.038267	
E	N	0.006438	0.010084	0.000786				0.017308
	NNE	0.004247	0.004191	0.000131				0.008568
	NE	0.002466	0.002226	0.000655				0.005347
	ENE	0.001370	0.003929	0.002881				0.008180
	E	0.000548	0.006810	0.007203				0.014561
	ESE	0.000274	0.004453	0.003405				0.008131
	SE	0.000548	0.004191	0.002095				0.006834
	SSE	0.000411	0.003667	0.000655				0.004733
	S	0.000411	0.001310					0.001721
	SSW	0.000274	0.001048	0.000524				0.001845
	SW	0.000137	0.001179	0.000262				0.001578
	WSW	0.000822	0.000786					0.001608
	W	0.000959	0.002881	0.001048				0.004888
	WNW	0.001507	0.004584	0.004191				0.010281
	NW	0.001644	0.009429	0.005107				0.016180
NNW	0.004932	0.009691	0.003667				0.018289	
F	N	0.018082	0.006679					0.024761
	NNE	0.019178	0.004715					0.023893
	NE	0.012877	0.003143					0.016020
	ENE	0.007260	0.003798					0.011058
	E	0.006027	0.003274					0.009301
	ESE	0.006164	0.002095					0.008260
	SE	0.004521	0.002226					0.006747
	SSE	0.007808	0.003536					0.011344
	S	0.005480	0.002488					0.007968
	SSW	0.005206	0.001179					0.006384
	SW	0.004384	0.001441					0.005824
	WSW	0.003973	0.001179					0.005151
	W	0.004795	0.002750					0.007545
	WNW	0.008219	0.004191					0.012410
	NW	0.013151	0.006417					0.019568
NNW	0.017808	0.006941					0.024749	

7,636 valid hours out of 8,784



Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE							
	SSE							
	S							
	SSW							
	SW							
	WSW							
	W							
	WNW							
	NW							
NNW								
B	N	0.005197						0.005197
	NNE	0.001890						0.001890
	NE	0.001890						0.001890
	ENE	0.000945						0.000945
	E	0.000945						0.000945
	ESE	0.000945		0.000463				0.001408
	SE	0.001890	0.000463					0.002353
	SSE	0.003307	0.001390					0.004698
	S	0.005670	0.000927					0.006597
	SSW	0.003780	0.000463					0.004243
	SW	0.004252						0.004252
	WSW	0.003307	0.000927					0.004234
	W	0.004725	0.003244					0.007969
	WNW	0.004725	0.001854	0.001390				0.007969
	NW	0.003780	0.000463	0.000927				0.005170
NNW	0.005670						0.005670	
C	N		0.002317					0.002317
	NNE		0.000927					0.000927
	NE		0.000463					0.000463
	ENE		0.000463	0.000463				0.000927
	E			0.003244				0.003244
	ESE		0.001854	0.002317				0.004171
	SE		0.003244	0.003244				0.006487
	SSE		0.004171	0.001854				0.006024
	S		0.002780	0.001390				0.004171
	SSW			0.000927				0.000927
	SW		0.002317					0.002317
	WSW		0.003707	0.000463				0.004171
	W		0.005097	0.000463				0.005561
	WNW		0.010195	0.008341				0.018536
	NW		0.014829	0.004171				0.018999
NNW		0.007414	0.003244				0.010658	

Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.010867	0.010658	0.002317		0.000463		0.024305
	NNE	0.007560	0.006487	0.000927				0.014974
	NE	0.003780	0.001854		0.000927			0.006560
	ENE	0.000945	0.003244	0.009268	0.003707			0.017164
	E	0.001417	0.006024	0.014365	0.008341			0.030148
	ESE	0.001417	0.005561	0.007878	0.000927			0.015783
	SE	0.000945	0.005561	0.005097				0.011603
	SSE	0.003307	0.005561	0.002780	0.000463			0.012112
	S	0.002362	0.003244	0.000463	0.000463			0.006533
	SSW	0.002362	0.002317	0.000927				0.005606
	SW	0.000472	0.000463	0.002780	0.001854			0.005570
	WSW	0.001417	0.002780	0.001390	0.002780		0.001854	0.010222
	W	0.000472	0.005097	0.004171	0.003244	0.002317	0.000463	0.015764
	WNW	0.003307	0.013902	0.024560	0.028267	0.005561	0.000927	0.076523
	NW	0.004252	0.016682	0.052363	0.055607	0.022243	0.001854	0.153001
	NNW	0.006142	0.015292	0.011585	0.008804	0.001390		0.043214
E	N	0.008977	0.013438	0.001854				0.024269
	NNE	0.006615	0.005561					0.012175
	NE	0.002835	0.000463	0.000927				0.004225
	ENE	0.000472	0.002317	0.002317				0.005106
	E	0.001417	0.004634	0.005561				0.011612
	ESE	0.000472	0.002780	0.004634				0.007887
	SE	0.000945	0.003707	0.003244				0.007896
	SSE	0.000945	0.000927					0.001872
	S		0.001390					0.001390
	SSW	0.000472		0.000463				0.000936
	SW	0.000472	0.000927					0.001399
	WSW	0.001890	0.000463					0.002353
	W	0.001417	0.003707	0.002780				0.007905
	WNW	0.001417	0.008804	0.009268				0.019490
	NW	0.002835	0.014365	0.008804				0.026004
	NNW	0.005197	0.013438	0.006024				0.024660
F	N	0.021262	0.008804					0.030066
	NNE	0.027876	0.006024					0.033900
	NE	0.016064	0.004171					0.020235
	ENE	0.010867	0.003244					0.014111
	E	0.006615	0.004634					0.011249
	ESE	0.004725	0.000927					0.005652
	SE	0.006615	0.001854					0.008468
	SSE	0.008977	0.004171					0.013148
	S	0.006142	0.001854					0.007996
	SSW	0.003307	0.000927					0.004234
	SW	0.003780						0.003780
	WSW	0.002835	0.000927					0.003762
	W	0.004252	0.002317					0.006569
	WNW	0.009450	0.006024					0.015474
	NW	0.016537	0.008341					0.024878
	NNW	0.023624	0.009268					0.032892

2,158 valid hours out of 2,184



Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE		0.000458					0.000458
	NE							
	ENE							
	E							
	ESE	0.000965						0.000965
	SE		0.000458					0.000458
	SSE	0.000483	0.000916					0.001398
	S	0.000483	0.001832					0.002314
	SSW	0.000483	0.002289					0.002772
	SW	0.001448	0.000916					0.002364
	WSW	0.000483	0.001832					0.002314
	W	0.000965	0.000916					0.001881
	WNW	0.001448	0.001374					0.002822
	NW							
NNW								
B	N	0.000965	0.000916					0.001881
	NNE	0.000965						0.000965
	NE	0.000483						0.000483
	ENE	0.001448	0.000916					0.002364
	E	0.000483						0.000483
	ESE			0.001374				0.001374
	SE	0.002896	0.004121	0.003205				0.010222
	SSE	0.001448	0.009615	0.003205				0.014268
	S	0.003861	0.005495	0.000458				0.009813
	SSW	0.002896	0.003663	0.000458				0.007017
	SW	0.003861	0.005495	0.000916				0.010271
	WSW	0.003378	0.008242	0.000916				0.012536
	W	0.000483	0.009158	0.002747				0.012387
	WNW	0.004344	0.006868	0.006868				0.018080
	NW	0.002413	0.001374	0.002289				0.006076
NNW	0.002413	0.000458					0.002871	
C	N		0.001374					0.001374
	NNE							
	NE							
	ENE		0.000458					0.000458
	E		0.002747	0.002289	0.000458			0.005495
	ESE		0.001832	0.006410	0.000458			0.008700
	SE		0.005952	0.003205	0.000458			0.009615
	SSE		0.004579	0.004579				0.009158
	S		0.007326	0.000916				0.008242
	SSW		0.001832	0.001374				0.003205
	SW		0.000916	0.002289				0.003205
	WSW		0.002747	0.000916				0.003663
	W		0.006868	0.002289	0.001374			0.010531
	WNW		0.010073	0.010531	0.000458	0.001374		0.022436
	NW		0.002289	0.004579	0.005037	0.000458		0.012363
NNW		0.002289	0.001374				0.003663	



Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.003861	0.006868	0.002747	0.001832	0.000458		0.015766
	NNE	0.003378	0.004121	0.001832	0.001374			0.010704
	NE	0.003378	0.004579	0.007326	0.003205	0.000458	0.000916	0.019862
	ENE	0.002413	0.008242	0.013278	0.024725	0.005952	0.007326	0.061937
	E	0.002896	0.006410	0.039835	0.027473	0.005495	0.002289	0.084398
	ESE		0.007784	0.012363	0.011447	0.002289		0.033883
	SE	0.001931	0.008242	0.010531	0.002289	0.000458		0.023451
	SSE	0.000965	0.004121	0.003663	0.002289	0.000916		0.011954
	S	0.001448	0.001374	0.001374				0.004195
	SSW	0.002896	0.000916	0.002747	0.000916			0.007475
	SW	0.001448	0.001374	0.000916	0.002747	0.003205	0.000458	0.010148
	WSW	0.000965	0.001374	0.005037	0.007326	0.002747		0.017449
	W	0.000483	0.003205	0.004579	0.006410	0.000916		0.015593
	WNW	0.001931	0.012821	0.015568	0.019689	0.005495		0.055502
	NW	0.004826	0.016941	0.033883	0.065018	0.023352	0.005952	0.149973
	NNW	0.005309	0.011905	0.008242	0.006868	0.003205	0.001374	0.036902
E	N	0.000965	0.007326					0.008291
	NNE	0.002413	0.003205	0.000458				0.006076
	NE	0.001931	0.000916	0.000458				0.003304
	ENE	0.000965	0.004579	0.005037				0.010581
	E		0.007784	0.007784				0.015568
	ESE		0.004121	0.002289				0.006410
	SE		0.004121	0.002289				0.006410
	SSE		0.002289	0.000458				0.002747
	S	0.000965	0.000458					0.001423
	SSW		0.002289	0.000916				0.003205
	SW		0.001374	0.000458				0.001832
	WSW		0.000916					0.000916
	W	0.000483	0.002289	0.000916				0.003688
	WNW	0.000483	0.000458	0.000916				0.001856
	NW	0.000965	0.005495	0.004579				0.011039
	NNW	0.002413	0.005952	0.001374				0.009739
F	N	0.008687	0.007326					0.016013
	NNE	0.009653	0.002747					0.012400
	NE	0.007722	0.002289					0.010011
	ENE	0.006274	0.004121					0.010395
	E	0.004826	0.002289					0.007116
	ESE	0.005792	0.002747					0.008539
	SE	0.001448	0.001374					0.002822
	SSE	0.001931	0.001374					0.003304
	S	0.002413	0.001832					0.004245
	SSW	0.004826	0.000916					0.005742
	SW	0.000965	0.001374					0.002339
	WSW	0.000965	0.000458					0.001423
	W	0.001931	0.002289					0.004220
	WNW	0.001931	0.003205					0.005136
	NW	0.006757	0.008242					0.014999
	NNW	0.005792	0.002289					0.008081

2,184 valid hrs out of 2,184



Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 1.4%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE		0.000873					0.000873
	SSE	0.000893	0.000873					0.001765
	S	0.001091						0.001091
	SSW	0.001983	0.000873					0.002856
	SW		0.000873					0.000873
	WSW		0.001745					0.001745
	W		0.000873					0.000873
	WNW		0.000873					0.000873
	NW							
NNW								
B	N		0.000873					0.000873
	NNE							
	NE	0.000893						0.000893
	ENE							
	E	0.001785		0.000873				0.002658
	ESE	0.000893	0.002618	0.000873				0.004383
	SE	0.001091	0.004363	0.007853				0.013307
	SSE	0.004165	0.006981	0.003490				0.014636
	S	0.005752	0.008726	0.002618				0.017096
	SSW	0.003967	0.002618					0.006585
	SW	0.001785	0.002618	0.000873				0.005276
	WSW	0.002876	0.001745					0.004621
	W	0.003769	0.009599	0.004363				0.017731
	WNW	0.004662	0.005236	0.006981				0.016878
	NW	0.001091	0.005236					0.006326
NNW	0.005950	0.000873	0.000873				0.007696	
C	N		0.000873					0.000873
	NNE		0.000873					0.000873
	NE							
	ENE							
	E		0.002618	0.000873				0.003490
	ESE		0.004363	0.004363				0.008726
	SE		0.004363	0.010471				0.014834
	SSE		0.007853	0.006981				0.014834
	S		0.006981	0.000873				0.007853
	SSW		0.002618	0.000873				0.003490
	SW		0.002618					0.002618
	WSW		0.003490	0.004363				0.007853
	W		0.007853	0.001745				0.009599
	WNW		0.015707	0.013962				0.029668
	NW		0.002618	0.007853		0.001745		0.012216
NNW		0.003490	0.001745				0.005236	

Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 1.4%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.007340	0.011344	0.003490	0.004363	0.000873		0.027410
	NNE	0.008629	0.006108	0.002618	0.000873		0.000873	0.019100
	NE	0.000893	0.001745	0.009599	0.006108		0.000873	0.019217
	ENE	0.002678	0.007853	0.028796	0.020942			0.060270
	E	0.004464	0.013962	0.031414	0.014834			0.064673
	ESE	0.004662	0.013962	0.027923	0.032286	0.001745		0.080578
	SE	0.001091	0.007853	0.013962	0.006108	0.000873		0.029887
	SSE	0.001091	0.002618	0.004363	0.002618	0.000873		0.011562
	S		0.004363	0.003490				0.007853
	SSW	0.003967	0.000873	0.002618	0.000873			0.008330
	SW		0.001745	0.006108	0.006108			0.013962
	WSW		0.001745	0.004363			0.000873	0.006981
	W	0.000893	0.000873	0.002618			0.001745	0.006128
	WNW	0.002678	0.006981	0.013962	0.027051	0.000873		0.051544
	NW	0.003967	0.006108	0.026178	0.030541	0.010471		0.077265
	NNW	0.004165	0.012216	0.006981	0.002618			0.025980
E	N		0.007853					0.007853
	NNE	0.001785	0.006108					0.007894
	NE	0.001983	0.005236	0.001745				0.008964
	ENE		0.006981	0.001745				0.008726
	E		0.010471	0.016579				0.027051
	ESE	0.000893	0.006108	0.006108				0.013109
	SE		0.002618	0.000873				0.003490
	SSE	0.000893	0.002618	0.001745				0.005256
	S		0.002618					0.002618
	SSW		0.002618	0.000873				0.003490
	SW		0.000873	0.000873				0.001745
	WSW		0.000873					0.000873
	W		0.002618					0.002618
	WNW		0.002618	0.000873				0.003490
	NW		0.006108					0.006108
	NNW	0.001785	0.001745	0.001745				0.005276
F	N	0.005752	0.004363					0.010115
	NNE	0.011109	0.003490					0.014599
	NE	0.007538	0.005236					0.012774
	ENE	0.005950	0.003490					0.009441
	E	0.002678	0.003490					0.006169
	ESE	0.004662	0.002618					0.007280
	SE	0.005356	0.000873					0.006229
	SSE	0.004860	0.007853					0.012713
	S		0.003490					0.003490
	SSW	0.000893	0.000873					0.001765
	SW	0.003769	0.000873					0.004642
	WSW	0.001983	0.000873					0.002856
	W	0.002876	0.001745					0.004621
	WNW	0.004662	0.003490					0.008152
	NW	0.010216	0.003490					0.013707
	NNW	0.003967	0.006108					0.010075

1,146 valid hours out of 2,208



Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 2.14%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE							
	SSE							
	S							
	SSW							
	SW							
	WSW							
	W							
	WNW							
	NW							
NNW								
B	N	0.003437	0.000466					0.003902
	NNE	0.000982						0.000982
	NE	0.000982						0.000982
	ENE	0.000491						0.000491
	E	0.000491	0.000466					0.000957
	ESE							
	SE	0.000982						0.000982
	SSE	0.002455						0.002455
	S	0.005892						0.005892
	SSW	0.009329	0.000466					0.009794
	SW	0.003437	0.000931					0.004368
	WSW	0.004910						0.004910
	W	0.006383	0.001397					0.007779
	WNW	0.003928	0.003259					0.007187
	NW	0.008838	0.001862					0.010700
NNW	0.002946	0.002793					0.005739	
C	N		0.000466					0.000466
	NNE							
	NE							
	ENE							
	E		0.000466					0.000466
	ESE		0.000931	0.000466				0.001397
	SE		0.001862	0.002793				0.004655
	SSE		0.004190	0.001862				0.006052
	S		0.005587					0.005587
	SSW		0.002328	0.000466				0.002793
	SW		0.001397					0.001397
	WSW		0.005587	0.000931				0.006518
	W		0.006983	0.000931				0.007914
	WNW		0.012104	0.005121				0.017225
	NW		0.006518	0.004190				0.010708
NNW		0.006518	0.000931				0.007449	

Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 2.14%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.011293	0.012570	0.000931	0.000466			0.025259
	NNE	0.011784	0.003724	0.001862				0.017370
	NE	0.001964	0.002328	0.001862	0.000931			0.007085
	ENE	0.001473	0.004190	0.007449	0.008845	0.002328		0.024285
	E	0.004910	0.006983	0.014432	0.013966			0.040292
	ESE	0.001964	0.006983	0.006052	0.004655			0.019655
	SE	0.000491	0.003259	0.004190	0.002328			0.010268
	SSE	0.004910	0.005121	0.005587	0.000931			0.016549
	S	0.005892	0.003724					0.009616
	SSW	0.004910	0.003259					0.008169
	SW	0.002946	0.000466	0.000466	0.000931			0.004808
	WSW	0.005892	0.002793	0.000466	0.001397	0.000466	0.000466	0.011478
	W	0.004419	0.003724	0.001397	0.002328	0.001862		0.013730
	WNW	0.006383	0.010708	0.019553	0.014898	0.004190	0.000466	0.056197
	NW	0.008838	0.020950	0.035382	0.031192	0.016294	0.003259	0.115914
	NNW	0.009820	0.020019	0.006983	0.002793	0.001862		0.041477
E	N	0.012766	0.010708	0.000931				0.024404
	NNE	0.004910	0.002793					0.007703
	NE	0.002946	0.003724					0.006670
	ENE	0.003437	0.003259	0.001862				0.008558
	E	0.000491	0.006052	0.003259				0.009802
	ESE		0.005587	0.001862				0.007449
	SE	0.000982	0.005587	0.001397				0.007965
	SSE		0.008380	0.000931				0.009311
	S	0.000491	0.001397					0.001888
	SSW	0.000491						0.000491
	SW		0.001397					0.001397
	WSW	0.000982	0.000931					0.001913
	W	0.001473	0.002793					0.004266
	WNW	0.003437	0.005587	0.004190				0.013213
	NW	0.001964	0.010242	0.004655				0.016862
	NNW	0.008838	0.013966	0.004655				0.027460
F	N	0.030932	0.005121					0.036053
	NNE	0.024058	0.006052					0.030110
	NE	0.017675	0.001862					0.019538
	ENE	0.005401	0.004190					0.009591
	E	0.008347	0.002793					0.011140
	ESE	0.008838	0.002328					0.011165
	SE	0.004910	0.004190					0.009100
	SSE	0.014239	0.002793					0.017032
	S	0.010802	0.003259					0.014060
	SSW	0.009820	0.001862					0.011682
	SW	0.008838	0.003259					0.012097
	WSW	0.009329	0.002328					0.011656
	W	0.009329	0.004190					0.013519
	WNW	0.015220	0.003724					0.018945
	NW	0.017675	0.004190					0.021865
	NNW	0.031423	0.009777					0.041199

2,148 valid hours out of 2,208

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